

ADJUSTABLE VEHICLE CONTROL PEDALS

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BACKGROUND OF THE INVENTION

The present invention relates generally to adjustable vehicle control pedals, and more particularly to such pedals which can conveniently fit into existing motor vehicle design packages.

For many years, vehicle manufacturers and/or designers have been aware of ergonomic considerations for drivers of different stature. In an effort to accommodate different sizes of drivers, vehicle controls (steering wheels, etc.) have been designed with adjustability to accommodate this wide range of driver size. The importance of creating a harmony for the occupant, whereby all vehicle controls adjust to the driver has been increasingly more important from an ergonomic and safety point of view. However, package space, functional safety and cost have historically excluded pedals from adjustability.

Thus, it is an object of the present invention to provide an adjustable vehicle control pedal apparatus which ergonomically accommodates drivers of different stature, yet advantageously substantially fits into current vehicle design packages. It is a further object of the present invention to provide such an apparatus which performs reliably, and can be incorporated in a vehicle at a relatively low cost. Yet further, it is an object of the present invention to provide such an apparatus which operates much like a standard pedal and advantageously allows for carryover hardware and switches.

SUMMARY OF THE INVENTION

The present invention addresses and solves the problems/drawbacks enumerated above, and encompasses other features and advantages as well. The present invention comprises an adjustable control pedal apparatus for use in a vehicle having a pitch axis. The brake and/or clutch pedal apparatus comprises a driven pedal arm rotatably and operatively mounted to the vehicle about a rotation axis substantially parallel to the pitch axis. An inner pedal arm is adjustably mounted to the driven pedal arm, and a pedal is attached to the inner pedal arm. The brake and/or clutch pedal apparatus further comprises means, substantially disposed within the driven pedal arm and the inner pedal arm, for varying the proximity of the pedal to the operator.

A preferred embodiment of the invention includes a jack screw which moves a block member having pins which travel in slots in the inner and driven pedal arms to vary the proximity of the pedal.

The accelerator pedal apparatus of the present invention comprises an inner pedal arm rotatably and operatively mounted to the vehicle about a rotation axis substantially parallel to the pitch axis. A driven pedal arm is adjustably mounted to the inner pedal arm, and a pedal is attached to the driven pedal arm. The accelerator pedal apparatus also comprises means, substantially disposed within the inner pedal arm and the driven pedal arm, for varying the proximity of the pedal to the operator.

A first alternative preferred embodiment of an adjustment apparatus for a brake pedal has a pedal arm which encompasses more of the inner pedal arm.

A second preferred alternative preferred embodiment of the invention is directed to an adjustment apparatus for a brake pedal and includes a driven pedal arm having a pair of slots for receiving a clevis mounted to a jack screw rod. The clevis is connected to the inner pedal arm connected to the clevis by a pin. The inner pedal arm has a slot receiving for a slide block. A pinion gear is moved around the jack screw to position the pedal arm and pedal.

A third preferred alternative embodiment of the invention is particularly directed to an adjustment apparatus for an accelerator pedal having a pedal assembly which is mounted to a bracket by a pivot shaft. The pedal assembly includes an inner arm and a pedal arm. The pivot shaft has a worm gear portion which engages a pinion on an end of a jack screw. The jack screw is rotatably mounted to the inner arm. The jack screw is received in a threaded member mounted to the pedal arm. The motor turns the pivot shaft to rotate the jack screw and move the pedal arm with respect to the inner arm.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects, features and advantages of the present invention will become apparent by reference to the following detailed description and to the drawings, in which:

FIG. 1 is a cutaway perspective view showing the adjustable brake pedal apparatus and accelerator pedal apparatus of the preferred embodiment of the present invention mounted to the body of the vehicle;

FIG. 2 is a back perspective view of the adjustable brake pedal apparatus of the preferred embodiment of the present invention;

FIG. 3 is an enlarged perspective view of the gear and screw pin-translating assembly shown in FIG. 2;

FIG. 4 is a side perspective view of the adjustable brake pedal of the preferred embodiment of the present invention, showing the angular offset between a slot in the driven pedal arm and an adjacent slot in the inner pedal arm;

FIG. 5 is a back perspective view of an adjustable accelerator pedal apparatus of the preferred embodiment of the present invention;

FIG. 6 is an enlarged perspective view of the gear and screw pin-translating assembly shown in FIG. 5;

FIG. 7 is a side view of the adjustable accelerator pedal of the preferred embodiment of the present invention showing the angular offset between a slot in the driven pedal arm and an adjacent slot in the inner pedal arm;

FIG. 8 is an enlarged schematic view showing a typical motor to drive cable to worm gear connection;

FIG. 9 is an isometric view of a motor vehicle showing the pitch, roll and yaw axes;

FIG. 10 is a side perspective view of a first alternative preferred embodiment of the brake pedal apparatus of the present invention;

FIG. 11 is a perspective view of a second alternative embodiment of a brake pedal adjustment mechanism in accordance with the invention;

FIG. 12 is a sectional side view showing inner and driven pedal arms of the second alternative preferred embodiment of the brake pedal adjustment mechanism of the present invention;

FIG. 13 is a top view of the second alternative preferred embodiment of the brake pedal adjustment mechanism of the present invention.

FIG. 14 is a partial side view of the pedal arm and slot of the second alternative preferred embodiment of the invention;

FIG. 15 is a perspective view of an accelerator pedal of a third alternative preferred embodiment pedal of the present invention;

FIG. 16 is a perspective view of the accelerator pedal adjustment mechanism taken from the opposite side of FIG. 17 of the third alternative preferred embodiment;

FIG. 17 is a side view of the accelerator pedal adjustment mechanism showing the pedal assembly in a depressed and non-depressed position of the third alternative preferred embodiment of the present invention;

FIG. 18 is a side view showing the adjustability of the brake pedal of the third alternative preferred embodiment of the present invention; and

FIG. 19 is a perspective view of the pivot shaft of the accelerator pedal adjustment mechanism of the third alternative preferred embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIG. 1, the two adjustable control pedal apparatuses of the present invention are designated generally as 10 and 10'. Adjustable control pedal apparatus 10 depicts a brake pedal apparatus. However, it is to be understood that this apparatus may work equally well as a clutch pedal apparatus. Adjustable control pedal apparatus 10' depicts an accelerator pedal apparatus. However, it is to be understood that any of the pedal apparatuses 10 disclosed herein may be useful for any vehicle control. Also, although a motor vehicle V is shown, it is to be understood that any of the embodiments of the vehicle control pedals 10 described herein may be equally useful in any type of vehicle, including but not limited to trucks, airplanes, and the like.

Referring first to the brake and/or clutch pedal apparatus, the adjustable control pedal apparatus 10 of the present invention comprises a driven pedal arm 12 rotatably and operatively mounted to the vehicle V about a rotation axis 14 substantially parallel to the pitch axis P. The pitch axis P, roll axis R and yaw axis Y are shown in FIG. 9. Driven pedal arm 12 may be operatively connected to the vehicle V by any suitable, conventionally known means. For example, shaft 16 may attach to any standard brake booster push rod and stop light switch and be retained by a clevis pin (not shown).

In inner pedal arm 18 is adjustably mounted to driven pedal arm 12. A pedal 20 is attached to inner pedal arm 18. The brake and/or clutch pedal apparatus 10 may be rotatably mounted to the vehicle V by any suitable means. However, in the preferred embodiment, the apparatus 10 is mounted in a support bracket 64 which is similar to the support of a conventional pedal. Both the inner pedal arm 18 and the driven pedal arm 12 are mounted on the same pivot shaft 66.

The brake pedal 20 includes a cam face which accommodates different foot sizes at varying points of adjustment. The cam face has a lower portion which curves toward the fire wall from the top portion of the brake pedal. When the brake pedal is in a full forward position the top portion of the pedal is in position for depression by the driver. However, when the pedal is adjusted toward the rear of the vehicle, the pedal raises and the lower portion moves outwardly so as to be in the position for depression by the foot of the driver. The pad 21 is preferably cast as part of the pedal 20; thus, the pad 21 would be "as cast" and provide for marketing/styling inputs such as molding in a trade name which could provide driver awareness of the adjustable pedal feature. However it is to be understood that a standard rubber/elastomeric or the like conventionally known material may be disposed on the pedal 20 to provide the pad 21.

Although it is to be understood that any suitable material may be used, in the preferred embodiment the driven pedal arm 12 and the inner pedal arm 18 are cast from a magnesium alloy. This is advantageous in that the cast magnesium alloys allow for integration of the complex shape to both house the gearing and screw (described further hereinbelow) and integrate the pad 21. It is further advantageous in that the cast magnesium alloys provide suitable strength while being light in weight. It is estimated that the weight of the brake pedal apparatus 10, including the motor M (described hereinbelow) is 2.20 kilograms.

The adjustable control pedal apparatus 10 further comprises means, substantially disposed within the driven pedal arm 12 and the inner pedal arm 18, for varying the proximity of the pedal 20 to the operator. It is to be understood that this varying means may comprise any suitable means, however, in the preferred embodiment, the varying means comprises a first pair of opposed slots 22, 24 defined in the driven pedal arm 12. A second pair of opposed slots 26, 28 are defined in the inner pedal arm 18, the second pair of slots 26, 28 being angularly offset from the first pair of slots 22, 24 (as best seen in FIG. 2), whereby there are two opposed sets 30, 32 of angularly offset slots, one set 30 comprising one of the driven pedal arm slots 22 and an adjacent inner pedal arm slot 26, the other set 32 comprising the other driven pedal arm slot 24 and the other inner pedal arm slot 28.

It is to be understood that the angular offset may be at any angle suitable to provide for desired pin 34, 34' translation and a subsequent predetermined pedal 20 movement with reasonable torque requirements for the motor M. In the preferred embodiment, the angle θ between a set 30, 32 of angularly offset slots is approximately 15° . It is to be further understood that the slot sets 30, 32 in either or both of the apparatuses 10, 10' may be disposed either above or below the respective pivot point on the pedal apparatus 10, 10'.

The varying means may further comprise two pins 34, 34' operatively mounted within the inner pedal arm 18, one of the pins 34 extending outwardly through one of the opposed sets 30 of angularly offset slots, and the other pin 34' extending outwardly through the other 32 opposed set of angularly offset slots.

The varying means may further comprise means for translating the pins 34, 34' in a first 36 or a second 38 direction, whereby when the pin 34, 34' is translated in the first direction 36, the pedal 20 is moved toward the operator, and when the pin 34, 34' is translated in the second direction 38, the pedal 20 is moved away from the operator. However, it is to be understood that, although first direction 36 is depicted in FIG. 4 as being in a generally upward direction, first direction 36 may be in any direction suitable to move pedal 20 toward the operator. Similarly, it is to be understood that second direction 38 may be in any direction suitable to move pedal 20 away from the operator. When the pedal apparatus 10 is rotated, the pad 21 on the inner pedal arm 18 provides a normal contact with the ball of the operator's foot through the adjustment.

Each pin 34, 34' comprises an inner bearing member 40, 40' and an outer bearing member 42, 42', the members being rotatable with respect to each other (see FIG. 6). Each bearing member 40, 40', 42, 42' has at least two opposed load bearing surfaces 41, 43. The inner bearing member 40 is translatable within the inner pedal arm slot 28 in one of the sets 32, and the outer bearing member 42 is translatable within the driven pedal arm slot 24 in the same set 32. The inner bearing member 40' is translatable within the inner

pedal arm slot 26 in the other set 30, and the outer bearing member 42' is translatable within the driven pedal arm slot 22 in the same set 30. The squared pins/bearing members 40, 40', 42, 42' provide a load bearing area on both arms 12, 18. This provides some area to transfer the load.

Although the slots 22, 24, 26, 28 are shown as being rectangular or oblong in shape, it is to be understood that these slots may be of any suitable geometric configuration.

It is to be understood that the pin translating means may comprise any suitable means, however in the preferred embodiment, this pin translating means comprises a block member 44 having two opposed ends 46, 48 and being disposed between the two opposed sets 30, 32 of angularly offset slots, the block member 44 having the pins 34, 34' extending outwardly from each of the two ends 46, 48, the block member 44 further having a threaded bore 50 extending therethrough, as seen in FIG. 3.

The pin translating means may further comprise a jack screw 52 threadingly engaged within the threaded bore 50 and longitudinally oriented about an axis 54 substantially parallel to a line perpendicular to the pitch axis P. A pinion gear 56 is attached to the jack screw 52. A worm gear 58 is meshingly engaged with the pinion gear 56. The screw 52 may be axially constrained by any suitable means; however in the preferred embodiment, this means includes a thrust bearing 88 into which the screw 52 may be press fit at one end. At the end distal from the thrust bearing 88, a suitable plug 92 receives screw 52 in plug bore 90. Plug 92 has suitable external threads 94 for threading engagement within plate 96.

Alternatively, block member 44 may be more square like in shape, being substantially the same length and height as bearing members 40, 40', 42, 42'. The axis 54 about which screw 52 is longitudinally oriented would then be approximately centered between bearing member 40 and bearing member 40'.

The pin translating means may further comprise means for driving the worm gear 58. It is to be understood that this driving means may comprise any suitable means. However, in the preferred embodiment, the worm gear driving means comprises a motor M and a rotating drive cable 60 operatively mounted to the motor M and to the worm gear 58. Although motor M is shown schematically apart from the pedal apparatus 10, it is to be understood that motor M may be pedal mounted in the brake and/or accelerator pedal apparatus; motor M may be mounted by support bracket 64; and/or motor M may be mounted by a separate bracket. Upon rotation of the worm gear 58 in a first direction, the block member 44 will be translated along the longitudinal axis 54 of the jack screw 52 and away from the pinion gear 56, and upon rotation of the worm gear 58 in a second direction, the block member 44 will be translated along the longitudinal axis 54 of the jack screw 52 and toward the pinion gear 56. As the end of block member 44 travel in each direction, the motor M will automatically shut down. The motor M will do so by any suitable means, including but not limited to a limit switch for detecting amp overload (overload limit switch); by automatically stalling at a predetermined torque value; a potentiometer; or an encoder wheel.

The cable 60 may be any suitable drive cable. However, in the preferred embodiment, cable 60 is a square end, rotating drive cable. It is to be understood that cable 60 may be operatively attached to worm gear 58 and motor M by any suitable means, such as by a suitable snap fit connecting assembly. However, in the preferred embodiment, as can be

seen in FIG. 8, the cable 60 is attached to motor M and then extends through a bore 70 in a plug 62 which has external threads 72. A collar 74 is press fitted to cable 60 and retains cable 60 in plug 62. A portion of the inner pedal arm 18 has an internal threaded bore 76 to threadingly engage with plug 62. The square end cable 60 end fits into a square detent or socket 78 in the worm gear 58. The plug 62 having the cable 60 and collar 74 therewithin is then engaged with bore 76 to retain cable 60 in worm gear 58.

The current vehicle design packages provide acceptable space to adjust both pedals 20, 20' about 63.5 mm rearward (toward the operator) and about 10 mm downward. Modifications to the dash may be required to move the pedals 20, 20' forward (away from the operator) about 12 mm. It is to be understood that these adjustments are exemplary only, and that the pedals 20, 20' may be made to adjust within a smaller or wider range.

Although it is to be understood that any suitable material may be used, in the preferred embodiment, the driven pedal arm 12' is cast from a magnesium alloy. The inner pedal arm 18' is preferably injection molded from a suitably rigid polymeric material. The advantages above with regard to the brake pedal apparatus 10 materials apply equally here; however, the accelerator pedal apparatus 10' may be even lighter in weight, due to the use of polymeric material(s) for the inner pedal arm 18'. The driven pedal arm 12' is preferably cast from a magnesium alloy to provide styling harmony with the brake pedal apparatus 10. The weight of the accelerator is estimated to be about 0.67 kilograms.

The pedal pad 21' may also include a cam face (as with brake pedal apparatus 10) to accommodate different foot sizes at varying points of adjustment. The cam face in both pads 21, 21' includes an elongated face (as compared to conventional pads) such that as the pedal apparatus 10, 10' is adjusted (as stated above), the pads 21, 21' maintain normal contact with the ball of the operator's foot through the adjustment.

Thus, additional adjustability is gained through the geometry of the cam faced pedal pads 21, 21'.

The remainder of the accelerator pedal apparatus 10' is as described above in relation to the brake pedal apparatus 10, 10'. For example, the pin translating assembly also operates through two diverging slots (22, 26) and (24, 28), one set 30 being on one side of the apparatus 10, and the other set 32 being on the opposed side of the apparatus 10'.

A first alternative preferred embodiment of the adjustable brake pedal apparatus of the present invention is depicted generally as 10" in FIG. 10. In this embodiment, the driven pedal arm 12' encompasses more of the inner pedal arm 18'. A slot 68 for worm gear 58 is defined in driven pedal arm 12' in order to compensate for movement of inner pedal arm 18' and insure that the connection of cable 60 to worm gear 58 will not be compromised during pedal apparatus 10", adjustment. Further, the sets 30, 32 of opposed slots are rectangular in configuration, and the pins 34, 34' are the squared pins/inner, outer bearing members 40, 42, etc. as described above in relation to FIG. 6. The shaft 16 (which is attachable to the standard brake booster push rod as described above) is fixedly attached by a suitable means to each of the opposed side of driven pedal arm 12'. A slot 86 is defined in each of the opposed sides of inner pedal arm 18' in order to prevent actuation of the brakes during pedal 20 adjustment. The remainder of the apparatus 10" is as described hereinabove in relation to apparatus 10.

A second alternative preferred embodiment of the adjustable brake pedal apparatus 110 is shown in FIGS. 11, 12, and

13. The brake pedal apparatus 110 is similar to control apparatus 10 and like elements are referred to with the same reference numerals and characters as set forth above. The brake control apparatus 110 includes an inner pedal arm 118 and a driven pedal arm 112 pivotally mounted to the support bracket 114 by pin 66 in the same fashion as discussed above. However, a different mechanism for varying the position of the inner pedal arm 118 with respect to the driven pedal arm 112 is utilized.

As shown in FIG. 12, the inner pedal arm 118 has a throughbore 114 at an upper end 115 for receiving pin 66. The pedal 20 is formed at a lower end 120 of the pedal arm as discussed above. A slot 122 is formed transversely through a center portion of the inner pedal arm 118. The slot 122 is angled at an angle of approximately 75° with respect to the axis of translation of the jack screw to prevent friction from holding the side block 124. As discussed below, the slot 122 permits movement of a slide block 124. The slide block 124 has a throughbore 126 for receiving a pin 128.

As shown in FIGS. 11, 12, and 13, the driven pedal arm 112 has a pair of spaced apart side portions 130. The side portions 130 are spaced apart to receive the inner pedal arm 118 therebetween. A throughbore 132 is formed at an upper corner 134 of each of the side portions 130 to receive pin 66. Thus, the inner pedal arm 118 and driven pedal arm 112 pivot about pin 66 in the same fashion disclosed above.

As shown in FIGS. 11 and 12, stud 138 is mounted to a lower corner 140 of the side portions 130 to pivotally attach the shaft 16 which is attached to the standard brake rod. The side portions are formed to permit location of the stud 138 in the same position relative to the bracket as with a conventional brake pedal. Thus, the brake pedal mechanism of the invention may be substituted for a conventional brake pedal arm as an after market accessory. A slot 142 is formed in each side portion 130 to guide a jack screw 146 as it moves the inner pedal. The slots 142 extend in a direction between the lower corner 140 and a rearward corner 144.

As shown in FIGS. 11, 12, and 13, the jack screw 146 has a connector 148 extending at one end from a threaded portion 150. The connector 148 has a pair of arms 152 which are spaced apart to receive the inner pedal arm 118 and slide block 124 therebetween. Each of the arms 152 has a hole 154 to receive pin 128 to connect the jack screw rod 146 to the slide block 124 and inner pedal arm 118. A pair of cotter keys 156 are positioned through the ends of the pin 128 to hold the pin 128 in place. The arms 152 of the connector 148 have a rectangular profile and are received in the respective slots of the driven pedal arm to maintain the alignment of the jack screw.

A drive mechanism 160 is mounted at the rear corner 144 of the driven pedal arm. The drive mechanism 160 has a housing 162 which is mounted to extend between the side portions 130. The housing supports the pinion gear 56 and worm gear 58. The pinion gear 56 is centered with respect to the side portions 130 to receive the jack screw 146 in a threaded bore 164. The pinion gear 58 is mounted in meshing contact with the pinion gear 56 to be driven by drive cable 60 and motor M as discussed above. The slots 142 of the driven pedal arm 112 maintain the alignment of the connector and the jack screw with the axis of the pinion gear 56 during the operation of the drive mechanism 160.

As shown in FIG. 11, the slide block 124 is free to move within the slot 126 of the inner pedal arm 118 when the jack screw 146 is moved. Because the inner pedal arm pivots about the pivot axis and the connector is guided along a chord which moves with respect to the pivot axis, the slot

126 in the inner pedal arm 118 permits the slide block 124 and pin 128 to move along the chord as the radial distance to the pivot axis varies.

Referring now to the accelerator pedal apparatus, and more particularly to FIGS. 1 and 5-7, the adjustable control pedal apparatus 10' of the present invention comprises an inner pedal arm 18' rotatably and operatively mounted to the vehicle V about a rotation axis 14' substantially parallel to the pitch axis P. Inner pedal arm 18' may be operatively connected to the vehicle V by any suitable, conventionally known means. For example, the throttle cable (not shown) may operatively attach throughbore 80.

A driven pedal arm 12' is adjustably mounted to an inner pedal arm 18'. A pedal 20' is attached to driven pedal arm 12'. The accelerator pedal apparatus 10' may be rotatably mounted to the vehicle V by any suitable means. In the preferred embodiment, the apparatus 10' is mounted on a pivot shaft 84 in a support bracket 82 (most of which is shown broken away in FIG. 1) which is similar to the support of a conventional pedal, including standard nut, bolt and plastic bearings. However, it is preferred that the accelerator pivot (as at rotation axis 14') will be moved rearward (as compared to conventional accelerator pedals) to help maintain ratio integrity (i.e. accelerator pedal travel to throttle angle ratio) during the various points of adjustment of pedal apparatus 10'. Further, power transmission may be synchronized through the cable 60 from the worm gear 58 on the brake pedal apparatus 10, 10'.

A third alternative preferred embodiment of a pedal adjuster apparatus 210 for use with an accelerator pedal is shown in FIGS. 15-19. The pedal adjustment apparatus 210 includes a pedal assembly 212 pivotally mounted to a support bracket 214 by a pivot shaft 216. The pedal assembly 212 includes an inner arm 218 and a pedal arm 220. The pivot shaft 216 is rotated by the motor M as discussed below to adjust the position of the pedal arm 220.

As shown in FIGS. 15 and 17, the support bracket is mounted to the vehicle V as discussed above. The support bracket 214 has a pair of arms 222 having apertures 224 for rotatably receiving the pivot shaft 216.

As shown in FIG. 19, the pivot shaft 216 includes a worm gear portion 226 which is disposed between a pair of cylindrical surface portions 228 which are rotatably received in the arms 222 of the support bracket 214. A gear wheel 230 is mounted to one end of the pivot shaft 216 to meshingly engage a gear 232 wheel mounted to the motor M. A pair of c-clips 234 hold the pivot shaft 216 in position with respect to the bracket 214. As shown in FIG. 16, the motor M is advantageously mounted to the arm 222 of the support bracket 214 adjacent the brake pedal 110.

As shown in FIGS. 16 and 17, the inner arm 218 has a body portion 236 extending between a lower stop portion 238 and a pair of rearwardly extending support arms 240. The pair of support arms 240 have apertures for receiving a pivot rod 256 for pivotally mounting of the pedal arm 220. The body portion 236 has a pair of side walls 242 and a center portion 244 defining a cavity. The side walls 242 are received between the arms 222 of the support bracket 214. Each side wall 242 has an aperture 246 in a lower forward corner to receive the pivot shaft 216. The inner arm 18 pivots on the smooth portions 228 of the pivot shaft 216.

As shown in FIG. 17, a pair of bearings 248 are mounted in the center portion 244 of the body portion 236 to rotatably support a jack screw 250. The jack screw 250 has a threaded portion 252 which extends from a pinion gear 254. The pinion gear 254 is positioned in the cavity between the side